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ABSTRACT

This paper reports on a study of a group of university women working in science at an academic institution. The group included professors, graduate students, researchers, post-doctoral students, and science educators. Data were collected in the form of interviews, field notes taken during participant observation, and analysis of group materials and other documents. The analysis includes particular description in the form of vignettes and direct quotes, general description in the form of taxonomies and diagrams, and interpretive commentary to provide explanation and connection within the analysis. This report also addresses the forming of powerful networks, obstacles to making it in the science field, and leaving the narrow academic track. The results of this study show the importance of providing women and girls with social networks, and emphasize how important it is that the science community consider the fact that most scientists are members of families. The minimal role that women scientists have in making decisions related to professional standards is also discussed. Contains 28 references. (DDR)

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Creating "Gender-Sensitive" Environments in the Science Community and Issues of Capital, Credibility, Conflict, and Power

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by

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Paper presented at the Annual Meeting of the American Educational Research Association, March 1997, Chicago, IL

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INTRODUCTION

Substantial research documents the under-representation of women and girls in science-related careers and science coursework (AAUW, 1992; National Science Foundation, 1992; Vetter, 1992). In addition, educational institutions, organizations, and policy-makers continue to establish policies that are "gender-blind" in that they ignore the issues and experiences unique to women and girls and fail to address important aspects of women's and girls' education that are critical to their futures (AAUW 1992; Harding 1991; Martin 1992). Furthermore, numerous researchers (Delamont, 1989; Harding, 1991; Martin, 1989; Oakes, 1990; Sadker, Sadker, and Klein, 1990; Schiebinger, 1990; Seymour, 1995) have described how, historically, inequitable social structures and unfair practices within the science community have served to limit and/or exclude women's and girls' participation in it.

What do concerned educators, groups, and institutions need to consider in order to support women's and girls' participation in science? There are groups and educators throughout the country who have sought to construct "gender-sensitive" learning environments for women and girls. These groups aim to provide females with access to science activities, education, and careers and with opportunities to acquire the knowledge, skills, and resources necessary for legitimate participation in the science and science education communities (AAUW, 1992; Davis, 1996a, 1996b; Keith & Keith, 1989; Kreinberg & Lewis, 1996; Varanka-Martin, 1996). Yet, as the research reported in this paper shows, despite women's and girls' ability to "capture" valued knowledge and skills, a combination of structural and social forces, conflicts, tensions, and dilemmas results in women's and girls' marginalization and/or exclusion from science.

THEORETICAL FRAMEWORK

Several issues must be considered when reflecting on the legitimate participation of individuals within a community, namely 1) the acquisition of the necessary knowledge, skills, and other resources valued in the community, 2) access to the community to acquire these competencies, and 3) open, equitable, and engaged participation in the group (Lave & Wenger, 1991).

Bourdieu (Bourdieu & Wacquant, 1992) and Delamont (1989) contend that in order to participate legitimately within a given group, an individual must acquire the capital[1]--knowledge, skills, economic resources, status, credibility, and social networks--valued by that community. Bourdieu argues that one's relative force and/or position within a community depends on the quantity and quality of one's capital. He contends that

> capital is what is efficacious in a given field, both as a weapon and as a stake of struggle, that which allows its possessors to wield a power, an influence, and thus to exist, in the field under consideration, instead of being considered a negligible quantity. (Bourdieu & Wacquant, 1992, p. 98)

Lave and Wenger (1991) suggest that individuals acquire the knowledge, skills, and other forms of capital valued in a community through immersion in its environment and legitimate participation in its practices. It is through social interaction with old-timers and novices in the community of practice that newcomers make transparent and come to learn the valued structures, knowledge, ways, practices, talk, and artifacts of the group.

However, legitimate participation is much more than the process of newcomers' learning. Embedded within the concept of legitimate participation is

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[1]Capital is what an individual has and uses that enables one to legitimately take part in the practices of a group. Capital takes several forms: Cultural capital (i.e., knowledge, skills, tacit competencies), economic capital (i.e., money, grants, scholarships), symbolic capital (i.e., prestige, awards, credibility in the community), and social capital (i.e., mentors and valuable networks) (Jenkins, 1992).

the idea that individuals interact and contribute as valued participants in the change and construction of new and evolving capital, values, and practices of the group (Lave & Wenger, 1991). Through legitimate participation, individuals and groups in the community

> act out their differences and discover their commonalties...and come to terms with their need for one another....Conflict is experienced and worked out through a shared everyday practice in which differing viewpoints and common stakes are in interplay. (p. 116)

Therefore, legitimate participation involves the interrelationships and interactions between diverse individuals and groups and their practices in the community and results in community development and change.

Yet, Lave and Wenger contend that structure and power relations within a community can open, limit, or close access to legitimate participation to individuals within it or to those who seek membership. Inequitable structures and practices within the community can impede an individual's or group's acquisition of needed capital, affect their legitimacy in the community, limit their sharing of common and differing viewpoints and new thinking, and inhibit their participation in the evolution of the community. Lave and Wenger point out that if access to participation is blocked, intentionally or otherwise, then individuals can be "disempowered" or "marginalized" within the community.

For example, in previous research (Davis, 1991), I found numerous examples of teachers, primarily men, who served as door-openers and gatekeepers to the progress of women in their careers in science. These men were powerful in that not only could they enable women to move forward in their careers but they could also impede their progress. These teachers had the opportunity to assist women as students in entering careers and, therefore, had the potential to change women's lives. What was critical to the women in that study was the support that they did receive from professors, teaching assistants, and research advisors. These

individuals opened doors with encouragement and assistance so that these women could continue to participate in the profession.

Thus, as Lave and Wenger (1991) state, "It should be clear that, in shaping the relation of masters to apprentices, the issue of conferring legitimacy is more important than the issue of providing teaching" (p. 92). Researchers contend that individuals who have positions of power within a "formal institutional context" and "the capacity and commitment to...provide or negotiate the provision of resources, support and opportunity for others" can act as institutional agents (Stanton-Salazar, Vasquez, & Mehan, 1995, p. 3).

> Institutional agents have the power to access, in multiple ways, various resources and opportunities under the control of either their own institution or neighboring institutions. Their status as agents is activated when they access resources on behalf of others... (pp. 3, 4)

Importantly, institutional agents can provide individuals with forms of support so that they might progress through institutional systems and be able to "exercise considerable control over their lives and futures" (p. 3).

This paper shows that as educators, schools, groups, and institutions aim to facilitate women's and girls' legitimate participation in science, it is important that they be "gender-sensitive" and recognize and address issues that pertain to women and girls, that make a difference in their education and their future careers (Martin, 1992), and that result in their marginalization and/or exclusion from science. A "gender-sensitive" approach includes: 1) recognizing the existence of gender bias in science and science education and attempting to remove it; 2) acknowledging other barriers to participation that women and girls face in their pursuit of science and science education, and seeking to remove those obstacles; and 3) examining the structures, policies, and practices of the science community and the ways in which they do or do not allow women and girls equal opportunity of access, capital

acquisition, and participation, including mentoring, voice, and decision-making power (Davis, 1996b).

This paper reports the results of a study of a science support group for women that aimed to be "gender-sensitive." This study asked the following questions:

•What were women's pathways to engagement and credibility in the science community? In contrast, what barriers--what beliefs, social structures, practices, and kinds of capital--interrupted, limited, and/or prohibited their legitimate participation?

•What capital prescribed by the science community was valued by the group studied and what capital did they disregard or discredit? What forms of capital valued by the science community remained hidden from view?

•What other capital did the participants in this group prefer and/or possess, and in what ways was it (or was it not) consistent with the capital valued by the science community?

•What other kinds of capital are necessary to construct "gender-sensitive" learning environments for women and girls?

STUDY SITE AND METHODOLOGY

The site for this study was Women in Science[2] (WIS)--a group of university women working in science at an academic research institution. WIS included professors, graduate students, researchers, post-docs, and science educators and was facilitated by a tenured professor. The group met to discuss issues important to them and other women in the science profession.

Data for this study was collected in the form of interviews, field notes taken during participant observation, and analysis of group materials and other

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[2]Pseudonyms for the names of individuals, groups, organizations, and institutions are used throughout to protect the confidentiality of informants.

documents. The analysis includes particular description in the form of vignettes and direct quotes, general description in the form of taxonomies and diagrams, and interpretive commentary to provide explanation and connection within the analysis (Erickson, 1986).

RESULTS

WIS participants came to their group wanting to know what has happened historically in science for women to be absent in large numbers. One participant asked, "...in terms of [the] history of science, how does the system get to be the way it is? Where does all this exclusion stuff come from?" The members of WIS sought information about the culture of science--the hidden values and ways of the science community and the implicit competencies expected of its members.

Through their use of the inquiry process, the group uncovered several key issues that come to bear in constructing the past and present roles of women in the science community, the history of their exclusion, and women's and girls' credibility and legitimate participation in the science community. These issues included: 1) the development of social networks and mentoring, 2) the investment of time in research and careers, 3) the acquisition of outside funding, and 4) the care of self and families and the development of relationships. WIS participants experienced tension, dilemmas, and conflicts within each of these issues. Furthermore, the degree to which women could discuss these issues, voice conflicts, and make decisions to change policy and practice within the community was key to their legitimate participation.

Below, I discuss the critical factors that WIS members illuminated surrounding capital, conflict, credibility, and, thus, power and legitimate participation for women in science. I then draw implications for science education in the conclusion of this paper.

Social Capital: Forming Powerful Networks, "Schmoozing" & Mentoring

Making contacts in the science community is crucial to obtaining access to the capital of the community and its practices. Whether the contact is a possible funding source, future advisor, principle investigator (PI), colleague, or someone to provide one with information or further networking, such connections result in familiarity with important organizations, institutions, individuals and key leaders within the profession and the acquisition of knowledge, position, power, status, and economic gain.

Schmoozing

Schmoozing is one way of making important contacts within the science community. The WIS participants described schmoozing as making telephone calls, attending receptions and cocktail parties, and meeting new people. One example of schmoozing that a member of the group often repeated was that of the researcher on the west coast who scheduled a yearly trip to Washington, D.C. just to have dinner with a person with position and power at NSF so that he might continue to receive NSF funding. Though the WIS participants understood the importance of making such contacts in order to get funding or important positions, some saw schmoozing as an activity that is less than honest, as individuals converse with others mainly to acquire something. They saw that some schmoozers overcommit--promise to accomplish more than they can do in order to get funding, matching grants, or a position.

In addition, WIS participants described the interactions and discourse practices of most professional and social settings in the science community as difficult to engage in. In such contexts, talk is not just about sharing knowledge, learning about current scientific discoveries, or about simply putting one's work

before one's peers for constructive criticism. WIS members viewed the talk in the science community as framed in competition and aggression. They described it as: speaking authoritatively, arguing "like cats and dogs," "being criticized...[and] judged unfairly," humiliating...," "a constant... chopping away," "yelling at you," being "on the hot seat," and arguing to find "truth to the death." Thus, they viewed interactions in science settings as intense, where one needs to continually prove oneself.

Furthermore, WIS participants reported that individuals in these contexts often pose questions, not for the purpose of finding out what someone knows and to learn from that, but instead, to let others know that only they know the answer or that the information that is shared is something that is important to his/her research and that "that should be acknowledged." These are two of the salient characteristics of what the women in WIS referred to as "posturing." For example, one WIS member told the following story.

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"You were on the 'hot seat' at seminars and meetings," she said. For example, one time she was asked to give a talk. The professor with whom she was working was in the room, and he asked her all these questions even though they had already discussed these issues before she gave her talk. I asked her, "Then why do you think that he was asking you those questions? Honestly, he knew all the answers." She explained that he did that in order to speak for himself, to make a statement for himself as to what was happening in his lab and that it was something that should be acknowledged. At the time, there were several professors who were involved in the research industry outside of the university. She thinks that he was trying to let people know that he was still an academic, still qualified in his field, and he was doing this through his questioning of her.

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Such ways of talking and interacting were very difficult for WIS members, and they contrasted greatly with the communication practices of the WIS group

which were based on the acquisition of increased understanding and support (Davis, 1996a). (For an example, see field notes below.)

However, WIS participants did realize that developing contacts and networks within the science community was important. Within the WIS group, members discussed with each other who might prove to be important contacts and what kinds of valuable information they might provide. For example, one member sought the advice of the group when a grant proposal she had submitted had been turned down.

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One member began the WIS meeting by telling the group that she didn't get an invitation to apply for this grant. She was really disappointed. One concern that she had was that if she did not get enough money in outside grants, she would have to teach an extra class and that would further limit her time to do her research. She did receive something in the mail about a state grant which required matching money from some other institution, organization, industry, or business. So she was trying to think who she could get to give her some matching money. Lynn mentioned a company in Iowa. Sandra knew of a huge organization that oversees other organizations and companies that might be a resource. The member facing the problem thought that she could also go back to a local company that was enthusiastic about her grant proposal in the first place and see if they might give her some funds. Sandra mentioned some people who might be willing to work with her on this matching grant; one individual was located in Kentucky.

Another member mentioned that it is important to make telephone contact with the people giving out the grants. From them, one can find out what they are looking for in the way of proposals and also to find out who had been given this kind of money before and for what. Sometimes they provide booklets that list who had received these moneys and what their projects entailed. Then an individual could call any one of these people and ask them for more information about their particular project and what factors they felt led to their getting funded. The member with the problem was surprised to hear about these booklets, and she wondered if NSF had such information available. The women around the table thought that maybe they did.

• • •

In this WIS meeting, participants shared with this member potential networks (i.e., the names of important individuals and their companies) whom she could contact for funding. Therefore, in the context of WIS, members began to construct for themselves a successful and, what may be perceived as, more direct and honest way to make important contacts and acquire capital and credibility in the science community that contrasted with traditional approaches such as "schmoozing." In addition, this new approach did not require the use of competitive discourse practices such as "posturing."

Mentoring

A mentor can be the most critical contact in one's career as working with a mentor is crucial in order to be considered legitimate in the community (Lave & Wenger, 1991) and therefore obtain access to its practices and its capital. Mentors can serve as institutional agents and can open doors for newcomers to the practices of the profession enabling them to acquire important knowledge, skills, and resources and establish credibility in the field (Lave & Wenger, 1991; Stanton-Salazar, Vasquez, & Mehan, 1995).

In the context of WIS, the importance of "who you work with" in the science community--who your mentor or advisor happens to be--was made explicit when the WIS group invited Professor Lisa Williams, a well known woman scientist, to a luncheon to speak to its members and other invited guests about "the culture of science."

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Professor Williams sat next to me, and a Russian graduate student was seated on the other side of her. Professor Williams was an older woman; her hair was thinning and short. She wore glasses. She is on the faculty of a major research institution, teaches at another well-known university, and does laboratory research at a large federal institution.

During the discussion at lunch, she expressed her knowledge about the culture of the science community, its explicit and hidden structures, the different perspectives that people have about success, and what it takes to "make it." Her social capital was extensive. She knew a great number of people in the science community. She could "do the lineage." She mentioned numerous names of people from various universities, organizations, and institutions and who they had worked under and where--reaching back into the old boys' network.

At one point in the conversation, she said, "It is important who you work with." She explained, "It's important that you feel comfortable with that person, but, importantly, it's the name of who you work with that really makes the difference. It identifies you."

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Therefore, not only is "who you work with" important to acquire access to the capital and practices of the community, it is also a powerful component to one's construction of overall identity within the field.

In addition, one WIS member pointed out that, often, as a graduate student, one is expected to "become a clone" of one's advisor. One is not allowed to be oneself or to have one's own direction. In this case, "who you work with" then results in more than receiving the guidance and advice of an advisor or mentor; "who you work with" determines "who you are" and "what you do."

Few WIS participants experienced much mentoring; few of the women in the group described their relationships with advisors and PI's as such. In contrast, one member emphasized that within the social interactions of their everyday work environment, "[P]eople are sucked in, chewed up, and spit out in little bits and pieces; it's the way things are done." For example, during a WIS meeting, one graduate student member recounted some of the inappropriate things that went on in the lab of her first graduate advisor.

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At one point, a female graduate student working in the lab was preparing to write a proposal to NSF like she had done successfully for the previous two years.

Her advisor did not want her to do that, and he brought in two male graduate students to meet with her and him. They criticized her work and tried to point out how useless it was to do and how it lacked any value. The WIS member at one point interrupted their attack of this woman and said, "How can you say that? It's not true." They then backed off.

However, within two days, her advisor told her that he did not want her--an angry and abrasive woman--working in his lab any longer. After she talked with the rest of her committee, one of them was willing to let her move to his lab.

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In this instance, the graduate student's advisor placed obstacles in the career paths of both these women. He attempted to discourage one from applying for funding from a prestigious foundation--funding that she had previously applied for and had been awarded. Such an award would have further established her credibility and productivity within the community and would have given her more opportunities and choices within her work. By removing the second graduate student from his lab, the advisor could have left her without a context to do her research, and, potentially, could have eliminated the possibility of her being able to acquire funding or complete her degree. As it was, another male faculty member provided her with a lab to continue her work.

For both women, their participation and credibility within the science community was threatened. Neither had the opportunity to safely speak out and express what was important to them in their education and/or careers or to make decisions that were free from reprisal. No supportive network in the form of mentoring existed for them.

The lack of good mentoring for women is one reason why the WIS group was formed. Graduate students, in particular, viewed WIS as an opportunity to get to know female faculty members and to learn from their experience about the science community. Since the group's inception, the WIS group advised and mentored graduate students, each other, and other individuals, helped them problem-solve

their difficulties, including the problems they had with advisors, and supported their engagement in science.

One member pointed out that it is important to offer support and "not let people be crushed by the system." One way to do that is to make explicit the dynamics of the community. For example, one professor stated:

> ...I might have ideas or insights that they might not have because they haven't been there, especially if they are graduate students....I can look at it from the other end, the power end of it, if you want to look at it that way, what could be going on with the professor...just give them that feeling about what's really going on....[S]ome of these situations that people find themselves in are one thing on the surface, but there's something else really going on....[J]ust having more experience and being older...understanding what drives some issues, but that just comes because I've been around longer and I've been at this longer and after that [it's] either because of what I've suffered through or what other people have suffered through...

This WIS member readily shared stories during group meetings illuminating experiences that she and other women had had within the science community--many of which were painful and frustrating. By sharing such stories, this WIS member acknowledged the ways in which women are treated within the system, legitimized other women's experiences, provided insight about bad and/or potentially bad situations, and helped individuals "take action about things." Through their interactions within the WIS group, participants made explicit--for themselves and others--the beliefs, goals, structure, and practices of the community that are often hidden from women's view, provided women with access to science practices, and worked to head-off, interrupt, and/or change the immanent results of discriminatory practices through mentoring and problem-solving. Thus, as institutional agents, the WIS members provided valued knowledge of the science community and support for others so that they might continue to participate in science practices, acquire knowledge, resources, and other capital and develop and maintain their credibility in the community.

Obstacles to Making It

Though the WIS group provided its members with support, within the context of their daily environments, they found themselves without a supportive network or context where they might talk about their beliefs and experiences in the science community and make important decisions regarding their educations or careers. For example, despite the many years of talk about the need for women scientists, one WIS member worked continuously to keep herself from falling into a cycle that would eventually disconnect her from her research and the science community. Maintaining a high level of research and obtaining large amounts of funding to support that research is critical to establish one's credibility and position within the science community and acquire more capital (Davis, 1991). However, as a non-tenured assistant professor, this WIS member came to a department dominated by men, and as she began her university position, several factors set her career onto a downward spiral. First of all, her department told her there were no specific requirements for achieving tenure. She was also told, once she arrived, that in addition to teaching the agreed-upon course that reflected her research interests, she would also teach two lab classes a year. She decided to be a "good citizen" and teach the lab courses as she believed that the extra teaching would probably be a plus for her. However, her large teaching load consumed her time and kept her from doing much research, and, in the long run, she found that teaching was not valued in her department. Furthermore, her research endeavors were not supported by her department. Because of the heavy teaching load, she was not given adequate time to establish a research agenda. She was not provided with any financial support or "start-up money" for her lab. She had to purchase all of the equipment and materials on her own.

She was regularly harassed by a tenured male colleague. He continuously criticized her and told her that she was not teaching the courses correctly which frustrated her and wore her down. He would yell at her in the hallway of the department about things that were untrue. He would rudely interrupt her meetings with graduate students. She relates that years later he admitted that "if I hadn't been a woman, he wouldn't have treated me that way."

Overall, her experiences during the first few years as an assistant professor were detrimental to her level of confidence and her performance as a researcher, served to distance her from the research community, and resulted in her tenure being postponed for two years. Her description and feelings about her experience were summed up when she said:

> I felt that when I first came to the department, I was very, very enthusiastic. I was on top of my research, very dedicated to research....Then through my experience when I first came, I think part of me did die. Part of me did die, eroded...[I got] off track (from doing research)...when I started teaching.... [T]hat's the part that this department they punish you for.... I don't have big grants and that makes you feel a little less....I gave and gave and gave and got punished for it, and I feel sometimes you get taken advantage of.

As the WIS member joined the academy as an assistant professor, instead of being cast in the role of researcher, she was relegated to the role of teacher--a role often seen as "women's work" (Liston and Zeichner, 1991, p. 111) and not valued. As with the aforementioned graduate students, she was set upon a course that would deter her from engaging in valuable practices that would enable her to establish her credibility within her department and in the greater scientific community.

Regarding these women's experiences, two issues appear of great importance. First, the lack of mentoring or networking within the community greatly influenced the legitimate participation of these three women. The absence of such social capital limited their participation in community practices and their acquisition of credibility and other capital in the field. In addition, the three women had little

voice within their work environment about what experiences were detrimental to them, what practices should be eliminated or changed, and what opportunities should be provided to further their careers. Men, in positions of power, made decisions that affected the quality and quantity of their participation and, thus, their credibility within the community and the courses of these women's careers.

In contrast, the women in WIS provided a supportive context to acquire capital and, thus, credibility within the community. Furthermore, WIS provided a setting for its members to voice issues, concerns, and problems relating to their educational and work environment and to make decisions, and then the group provided support for members to "take action." The following field notes provide an example.

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At about 5:20 PM the WIS meeting started to break up. Someone had to leave which made everyone look at their watches and realize what time it was. One member quickly asked a last minute question, "What would you do if you were asked to serve on a committee as a token woman?" It was clear to her that she had been asked to be on the faculty search committee because she was a woman. "We need to have a woman on this committee," she was told.

Another faculty member stopped her exit and gave this question her attention as did the other individuals in the room. The importance of the committee was noted as it meant the possibility of bringing women faculty to the department.

The member with the dilemma also mentioned how she was already overwhelmed with a lot of committee work, including faculty evaluations which was very time consuming. It was suggested that she negotiate to get off of that committee to be on this one. The member seemed to appreciate the suggestions. People then began to depart.

The following week the WIS member mentioned that she had taken the advice of the group and talked to the chair. She told him that she would like to serve on the committee, but that she was overworked with her evaluation committee assignment. Could she just change committees? It was coming up for a

faculty vote that afternoon and he hesitated. She asked, "Can't you delay the vote on that committee?" He did.

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This WIS member saw that without the support of the women in the group and the opportunity that she had to discuss her problem, she

> might not have had the courage to go to the department chair and say, "Yes, I'll do that, but take me off...this other one." I might have rolled over and died...accepted all the committee work they wanted to lay on me and just do it instead of standing up for myself. Because sometimes you think--by yourself... you aren't talking to other people about things--you think, "Oh my gosh, why should I be complaining about this?" But then, other times you look at what your colleagues are doing--they wouldn't do that.

The group provided a context for women to state what they valued and their needs and experiences regarding their education and work environments and to express how policies affected them. Some of the issues they discussed included discourse practices in the science community, alternative careers to academia, and the balancing of family and career. The group then encouraged women to make decisions that supported their personal and professional goals and to take action in their daily settings. They had few opportunities to interact with others and participate in such ways in their educational and work environments.

Time: The Tyranny of the Urgent

One issue that caused much conflict for WIS participants was the use of time within science. For the WIS participants, conflicts existed between the amount of time the science community prescribed for one to be creditable and have a successful career, and the amount of time that women in WIS argued as important for their personal lives. Though WIS members talked about these conflicts, they appeared to have little say in their daily science settings about the ways in which time is valued and used.

Several WIS members emphasized the availability and use of time as being central to their ability to work in science. Being able to meet the science community's expectations of how much time should be spent on a project so that it will be productive and successful is critical. One WIS participant explained, "[T]hey look at what you are proposing to do [and your] productivity in the previous period" in order to determine if one's "ambitions" are "realistic" and "reflect the time that you have to put into it."

WIS members discussed how the science community's ideal is for individuals to invest large amounts of time into their work. However, they also pointed out how time investment can be misconstrued to mean productivity. For example, there is the expectation that labs be up and running around the clock. Lights are often left on. Graduate students are expected to run experiments throughout the night even though the work that they are doing could be done during regular working hours. One WIS member told the story of the faculty member who delivered her baby at a local hospital and then drove herself to the lab to make sure that it was in full operation. A WIS member stated:

> [T]here can be the sense that no matter whether your work is going well...it is simply because you are not here, [that] you are not up to par....[T]hat's the only way to gain respect. That is a really big issue. It seems like it was really true in graduate school that somehow the number of hours you [spent] in the lab [was] a measure of the quality of your work and your dedication rather than what you accomplish[ed]. Of course there were plenty of people that...spent their lives there, but they certainly weren't working every minute that they were there.

Time is also required to publish in the journals of one's field, present one's research at professional meetings, and give seminars at other institutions--all of which are important to establish one's credibility within one's field and to secure funding. One WIS participant stated:

> It is also a matter of how many meetings do you go to--the public exposures, how many seminars you...give at other institutions. I don't

> generally accept any invitations to...give a seminar at an institution because I feel I can only make a few trips a year and I'm better spending them on a meeting where I will get to talk to a dozen people doing relevant things rather than to go to one institution. But all of those things contribute to your image in the field....Are you really out there and seen at all the important meetings?

However, travel to such meetings, again, takes one away from one's family. The decision to spend time with family as opposed to one's career has its consequences. She continued:

> ....Not to be able to go to all the meetings I have been invited to, not to be able to go to the seminars I am invited to--it all helps to put you in kind of a lesser group. It affects people's perception--I mean people in our department say things to me like, "Well... you don't really work full time." People at meetings have said, "Oh, I am really surprised to see you here. I thought you didn't go to meetings much any more" and stuff like that. It definitely cycles back to you.
>
> ....[T]he choice I made to have children, the choice I make to spend time with them, these are to the detriment of my career. I mean if I didn't have children--[a] good friend about my age, she doesn't have children, and she travels every month--here, there, everywhere--she works long hours at the lab. She has made a different choice, and so she...can do those things that I have chosen not to do. I don't regret my choice. I only regret that it has a negative effect on my career....How to have your children and time with them and still have your competitive career?

The expectation in the community that scientists should put in 70-90 hours per week in the lab leaves one to believe that there is little expectation that a research scientist could have a life that is balanced between career, family and friends, self-reflection, and personal growth. For example, when Lynn, a WIS member, was enrolled in graduate school, twelve hours a day of class and lab time left her little time to take care of herself, spend time with others, study, or hold down a job. To continue, she would have had to work around the clock.

The following field notes provide other examples of conflicting priorities around time.

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I asked the members of the group how they deal with so much to do. In the book review we had read, it talked about the quality of one's work as opposed to the quantity. I told them that as I get further along in my graduate work there's so much more that has to be done. Quality is still expected, and the work requires more reading and more thinking than I did before. It becomes at times physically and mentally impossible to do all this work and to do it well. How do they make choices about what they're going to do? Do they do all of it?

One member looked like the whole idea exhausted her. She talked about the "tyranny of the urgent" and how the demands of people and the things that need to be done may not be important, but that they are "urgent" and can take up so much of one's time. "You're not supposed to have a self," that was said by members of the group.

I said that it was really important that I take care of myself. If I didn't take care of my physical, emotional, mental, and spiritual health, I wouldn't be able to do anything. One member said, "Yea, but you don't tell anybody that; just don't tell them." For example, she told very few people that she was taking a backpacking trip during spring break, because what would they think if they knew that she was taking a vacation? So it is something that she keeps to herself.

• • •

The conflict around time is "a tough one" and even more complex. Martha, another WIS member explained:

> It is not only the problem of respect and equality but it is a practical problem, too. Grants are very competitive now--very difficult to get. Someone who is working 40 hours a week...can't get as much done probably as someone who is working 70--no matter how focused and how good you are--you could still do more if you were here more.

The demand on one's time increases when one is engaged in intense competition for credibility and economic rewards. As reported in earlier research (Davis, 1991), scientists may work around the clock when in competition with other researchers to be the first to solve a problem or answer a question. The rewards for being number one come in the form of being first author of an article, receiving the coveted Nobel Prize, and/or acquiring other awards and money (Davis, 1991; Stephan & Levin, 1992).

Underpinning the availability of time to commit to one's work is the economic and/or cultural capital that individuals do/do not have to "purchase the time of others" or to use methods and/or machines to complete tasks within the home or within the workplace. Bourdieu (1986) contends that "among the advantages procured by capital in all its types, the most precious is the increased volume of useful time" (p. 258). Purchasing the use of labor and machines "make it possible to derive greater profit not only from labor time, by securing a higher yield from the same time, but also from spare time" (Bourdieu, 1986, p. 253).

The availability of technology greatly influences the productivity of a scientist and his or her lab. Giere writes, "The overwhelming presence of machines and instrumentation must be one of the most salient features of the modern scientific laboratory....The development of science depends at least as much on new machines as it does on new ideas (in Stephan & Levin, 1992, p. 13).

Yet, it is costly to purchase the equipment to run a lab and to fund the work of graduate students and post-docs, and if the salaries of women in science as compared to those of men reflects women's ability to acquire such support and technology, then there is also a "glass ceiling" to their access of time-saving and time-producing resources within the community.[3] Therefore, it is not just how much time one can spend, but also how much time in the form of labor one can purchase from others (i.e., technicians, graduate students, and post-docs), and how much time one can save and how productive an individual can be when he/she can purchase and/or get access to modern technology, and how much "free time" one then has because one's career needs are met by others.

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[3]For more information on women's salaries in the science, math, and engineering professions, see Vetter, B. M. (1992). What's holding up the glass ceiling? Barriers to women in the science and engineering workforce. Washington, D.C.: Commission on Professionals in Science and Technology.

As women within the science community are faced with the dilemma around time commitments, it is important to reflect, as Martin (1991) did, on the questions posed by Virginia Woolf in Three Guineas where, as women cross "a bridge connecting two worlds: private and public, home and professions, women's and men's"--she asks, "'On what terms shall we join the procession...of educated men?'" (Woolf in Martin, 1991, p. 13). Martin (1981, 1991) contends that arenas traditionally dominated by men consist of ideals that reflect the lives, experiences, and activities of men. For example, the huge time commitment required by science, is an ideal constructed in a profession dominated by men, men who have had and/or do have stay-at-home-wives who carry the responsibility of caring for the home and the family. Such ideals are "narrow," and Martin argues that "sex and gender *has* to be taken into account if an ideal...is not to be biased" (Martin, 1981, p. 109). Ultimately, the ideals within a community determine what values and practices are creditable and which are not, and, consequently, who is a legitimate participant and who is not.

Therefore, several factors regarding time come together to affect women's credibility in the field and their acquisition of funding: 1) the amount of time that the science community perceives as necessary for individuals to be productive and creditable, 2) the time that is actually needed to do good research, present one's work, and publish, 3) the amount of time some individuals are willing to promise in an era of intense competition for money, and 4) the amount of time women with children have, can purchase, and are willing to commit to their work and their personal lives. As one WIS member pointed out, considering the competition within the community and the fact that "the system is under a lot of pressure...in terms of...not enough to go around for all the good work there is to be done, it is easy to see the women getting squeezed out because they put in fewer hours." The expectation of spending 70-90 hours in the lab in order to be creditable within the

community creates a "logical" explanation as to why women who invest time with family do not acquire the capital and credibility necessary to be legitimate within the community and why they do not succeed. Yet it keeps hidden the complexity of the issue--how the ideals have been constructed by a male-dominated community and how some ideals conflict with the experiences, expectations, and values of women, how women have little voice in constructing and reconstructing what is valued in the community, and the reality of how the economic advantage held by others provides them with inequitable amounts of time and opportunity.

Jumping Off the Straight and Narrow Academic Track

As the women in WIS reflected on the conflicts between their values and those of the science community, they made decisions about how to maintain their careers in science. Some women faced the point of "jumping off the...straight and narrow academic track"--defined by traditional research science as "grad student, post-doc, first job, preferably at an early age" and considered other career options. However, such a change in career paths appears to further diminish one's value and credibility within the science community. WIS members reported that women who dealt "with these things in a different way by either sharing a position with someone, like a husband and wife team...or trying to find an alternate career [to academic research science]...so that they [can] live their life and have a [science career] at the same time" were criticized or frowned upon. One WIS member pointed out:

> It's a crime to tell students, give the message that the only enlightened path is to be a professor and have your own lab...[be]cause how many jobs are their going to be? But there's extreme pressure to just follow one pathway, and that they would feel like "science drop outs" if they would do anything different.

Positions outside of the traditional academic research setting are not valued and are often considered "dead-end jobs."

Engaging in research and working within academia not only carries with it enormous credibility within the science community, but also economic advantage and increased participation. Furthermore, Zuckerman (1977) points out that elite individuals and institutions, in particular, are often exponentially advantaged when compared to others in the research community. Individuals who are advantaged appear to continue to be advantaged which allows them to not only get ahead but also pull away from the pack. The process appears to justify itself "since recipients of resources are more likely to achieve" and it is then "argued that the system of allocation is effective and legitimate" (p. 61). Overall, the credibility that comes with being tenure-track faculty in academia, especially at an elite institution, is not easy to disregard.

Several of the women in the WIS group made decisions to jump off the narrow academic track and found ways to use their talents and continue their interests in science. For example, one of these WIS members, as a science educator, tapped the resources of the science academy to provide access to science to a wider group of people who might not otherwise experience science (girls, women, and minorities). It is difficult to calculate what the costs are to women's futures in science as they jump from the ideal pathway--the traditional academic track. It appears, though, that leaving research science and academia is perceived by many as leaving the science profession.

IMPLICATIONS FOR EDUCATION

WIS participants made explicit the conflicts that they experienced with the valued capital, ways, structures, and practices of the science community, the ways these conflicts affected their credibility in the field, and, thus, their legitimate

participation. Based on this information, there is much that individuals, groups, and institutions can address as they aim to be gender-sensitive and provide women and girls with opportunities to legitimately participate in science. Key elements to consider include: providing strong, supportive connections with the science community and developing contexts where women and girls can express their values, needs, and experiences as they relate to their educational and work environments and make decisions that support their personal and professional goals.

The results of this study show the importance of providing women and girls with social networks/connections with individuals in positions of power in the science community. Such networks help individuals acquire valued knowledge, skills, resources and establish credibility in the field and, thus support legitimate participation. However, one of the reasons WIS existed was because such contacts were not forthcoming. In fact, on many occasions, individuals in positions of power placed obstacles in women's and girls' paths to science participation. Much of the support females experienced came from their groups. Thus, individuals, groups, institutions, and organizations need to provide women and girls with positive mentoring and support within science.

Data from this study further illuminates the tensions and dilemmas that WIS participants faced as they strove to be successful in their educational and career endeavors and, simultaneously, raise children, develop and maintain personal relationships, and care for themselves. Data from the study emphasizes how important it is that the science community consider the fact that most scientists, both male and female, are members of families and are social beings and that the expected investment of hours into one's work--whether it is working in the lab, teaching in the classroom, presenting at conferences, or collecting data in the field--take into consideration the time that is also needed to care for children and one's

home, to interact with others, and to invest in personal growth (i.e., mental, emotional, spiritual, and physical).

One way to be gender-sensitive would be to establish structures and programs that support women and girls (and men and boys) in multiple roles. For example, researchers (Thurber in Hansen, et al., 1995) suggest that as organizations invite girls to their programs, they should also invite girls to bring younger siblings or other children under their care and/or provide child care.[4] In addition, the profession can provide a supportive working environment for its members--male and female. Flexible hours and work schedules, available and affordable child-care, the inclusion of child-care facilities within the contexts of educational settings, laboratories, and research institutions would acknowledge education, career, family, and relationships--all as valuable.

Furthermore, this study indicates that the women in WIS had very little decision-making power regarding not only the standards of their profession but also the educational and career experiences that they had. What clearly emerged in this study is the absence of contexts for women and girls to voice what values are consistent or inconsistent with their personal and professional goals, what experiences are supportive or detrimental to them, what policies and practices should be continued, changed, or created, and what opportunities should be provided. This was evident whether one was a graduate student working in laboratories under advisors; a faculty member attempting to balance research teaching, and service to the department; or a women scientist maintaining a career and family relationships.

Thus, it seems important that as individuals, groups, and institutions consider ways to provide equal opportunities for women's and girls' legitimate participation in science, education, and other settings, they must consider more than

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[4] This same invitation should also be made for boys.

providing access to the community and activities to compensate for those experiences missed. All individuals, especially those who are not part of the dominant group (such as women and girls in the science community), must have the opportunity to share within the community their experiences and how they relate in the social context, how policies affect them, and be able to create and change policy that affects themselves (Young, 1990).

Young (1990) emphasizes that for social equality, the "inclusion and participation of everyone in public discussion and decision-making" is necessary (p. 115). She describes several mechanisms that should be provided for the successful representation and acknowledgment of voices and perspectives. She describes the first of these mechanisms as the

> self-organization of group members so that they maintain a sense of collective empowerment and a reflective understanding of their collective experience and interests in the context of the society [and]...[v]oicing a group's analysis of how social policy proposals affect them... (p. 124)

This mechanism was already evident in the WIS group. Over time, the activities of this group resulted in group members' increased awareness of their experiences as women in the science community. In addition, they came to see how the contributions, interactions, and support of the group empowered them to speak up for themselves, express how practices affected them, construct new practices, and create change within their everyday environment.

As modeled in the WIS group, women and girls must speak and make judgments and decisions within multiple contexts such as local science programs and the everyday school and work environment. Empowerment comes as women and girls draft the blueprints and strategies for their learning and professional development (Nicholson & Fredericks, 1991), create and implement goals, policies, programs, activities, and career experiences, and reflect on the effectiveness of their

choices and what goals, policies, and practices should be maintained, modified, or discontinued.

Young (1990) emphasizes that as groups generate "policy proposals...in institutionalized contexts," decision-makers must be obliged to show that they have taken these perspectives into consideration (p. 124). Thus, the science and science education community must take responsibility for hearing the experiences, interests, and perspectives of women and girls. In addition, groups, such as women and girls, must have "veto power" within the community regarding specific policies that affect them (p. 124).

Furthermore, as individuals interact with others in a community, it is important to consider factors that affect the ability of all individuals to participate fully in the group's discourse. Communication is critical to legitimate participation (Lave & Wenger, 1991). Not addressing and making explicit the communication roadblocks (i.e., the use of competitive, aggressive talk and "posturing") and failing to incorporate open and inclusive ways of communication and construct safe settings excludes individuals from the community.

In sum, a multitude of structures, groups, individuals, and organizations--the science community, national funding bodies, state and local governments, local funding agencies, universities and schools, and private organizations and groups--need to 1) provide women and girls with valuable connections and supportive networks within the science community; 2) provide women and girls with opportunities to meet in collective groups and share facets of their lives that are important to their educational, social, physical, emotional, and economic well-being; 3) establish safe settings where women and girls can express how various experiences and practices affect them; and 4) empower women and girls to make decisions about what they will experience as part of their educational and/or science programs, coursework, and careers. These steps are critical to women's and girls'

acquisition of capital and credibility within the community, their legitimate participation in its practices, and the development of equity within science and science education.

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